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GPS или GLONASS?

Вопросы использования различных навигационных спутниковых систем являются сегодня важными не только для правительств различных государств, но и для обычных потребителей. В данный момент существует несколько навигационных спутниковых систем. Данное исследование дает представление об основных характеристиках, достоинствах и недостатках существующих навигационных систем.

GPS or GLONASS?

Nowadays the problem of choice of a navigation system has become important not only for governments of different countries, but also for ordinary people. This article has to answer a question: which navigation system is more accurate and easier to use.

There are three global navigation systems: Russian GLONASS, American GPS, and French GALILEO. It is worth noting French system isn’t a competitor to two other yet, therefore Russian and American systems are in the focus of the research.

GPS

Global Positioning System was developed by the United States' Department of Defense. It uses 31 Medium Earth Orbit satellites that transmit precise microwave signals. This enables GPS receivers to determine their current location, time and velocity. The GPS satellites are maintained by the United States Air Force.

GPS is often used by civilians as a navigation system. On the ground, any GPS receiver contains a computer that "triangulates" its own position by getting bearings from at least three satellites. The result is provided in the form of a geographic position - longitude and latitude - to, for most receivers, within the accuracy of 10 to 100 meters. Software applications can then use those coordinates to provide driving or walking instructions.

There are some technologies, which help GPS to determine the location of the receiver:

1. A-GPS – a system that is often able to significantly improve the startup performance;
2. S-GPS – a method to enhance a mobile phone's satellite-based position reporting ability to a carrier.

All satellite broadcasts are at the same frequencies, encode signals using unique CDMA so receivers can distinguish individual satellites from each other.

GLONASS

An acronym for Globalnaya Navigatsionnaya Sputnikovaya Sistema (Global Navigation Satellite System), GLONASS is a Russian Aerospace Defense Force-operated satellite-based navigation system that is very much like GPS. While GPS came first, created by the United States Army in 1978, GLONASS was invented as an alternative system. GLONASS is the most expensive program of the Russian Federal Space Agency, consuming a third of its budget in 2010. Nowadays there are a lot of modifications and new versions of GLONASS:

- GLONASS-M – launched in 2003. It addedthe second civil code. It is important for GIS mapping receivers.
- GLONASS-k – started in 2011. It again had 3 more types named k1, k2 and km for research. It also added the third type of civil frequency.

RosCosmos plans to launch two more useful modifications:

- GLONASS-K2 – will be launched after 2015 (currently in design phase).
- GLONASS-KM – will be launched after 2025 (currently in research phase).

Another expansion of GLONASS is A-GLONASS. It’s very similar to GLONASS but it brings more features for smartphones such as turn by turn navigation, real time traffic data and some other. A-GLOASS uses the cell towers near your location to lock your location quickly with the help of your data connection. A-GLONASS also enhances the performance in chip-sets that come with GLONASS support.

GLONASS first used the FDMA (Frequency Division Multiple Access Method) channel access method to communicate with satellites, with 25 channels for 24 satellites. This is a popular protocol used in satellite communications, but has the disadvantage of crosstalk causing interference and disruption.

Since 2008, GLONASS has used CDMA (Code Division Multiple Access Technique) in order to allow compatibility with GPS satellites. Therefore, GLONASS receivers are compatible with both FDMA and CDMA, despite they are both larger and more expensive.

Specification	GLONASS	GPS
Owner	Russian Federation	The USA
Coding	FDMA + CDMA	CDMA
Number of satellites	24	31
Satellites per orbital plane	8 and evenly spaced	4 and unevenly spaced
Orbital Height	21150 km	19130 km
Accuracy	Position: 5–10 m	Position: 3.5-7.8 m
Orbital plane inclination	64.8 degree	55 degree
Orbital period	About 11 hour and 58 minutes	11 hours and 16 minutes
Repeat ground track	Every sidereal day	Every 8 sidereal day
Clock data	Transmitted in terms of Clock offset, frequency rate and allow the calculation of the differences between individual GPS satellite's time GPS-system time	Broadcasted Clock and frequency offset provides difference between time of GLONASS satellite and GLONASS system
Orbital data	Modified keplerian orbital elements every hour	Satellite position, velocity and acceleration every half hour
Frequency	Around 1.602 GHz (SP) Around 1.246 GHz (SP)	1.57542 GHz (L1 signal) 1.2276 GHz (L2 signal)
Status	Operational	Operational

Table 1. Comparison of GLONASS and GPS specifications.

There are some significant differences between GLONASS and GPS.

On the one hand, GLONASS has fewer satellites in its constellation. GPS has 32 which circle the globe in 6 orbital planes, or paths of orbit. GLONASS has 24 satellites with 3 orbital planes. This means that more satellites follow the same orbital path with GLONASS. It might be more difficult to connect to available satellitesfor the systems usingGLONASS only. This could potentially lead to reduce positioning accuracy.

The biggest difference between GPS and GLONASS is how they communicate with receivers. GPS satellites use the same radio frequencies but have different codes for communication. GLONASS satellites have the same codes but use unique frequencies. This allows satellites to communicate with one another despite being in the same orbital plane, whereas this is not a problem for GPS.

There is no clear advantage other than accuracy over GPS. GLONASS doesn't have the same strong coverage as GPS has, but when both are used together it increases accuracy with coverage. And it is more useful in northern latitudes as Russia started GLONASS originally for Russia.

The accuracy is an advantage of GLONASS with up-to 2 meter of accuracy. GPS + GLONASS allow your device to be pin pointed by a group of 55 satellites all across the globe. So when you are in a place where GPS signals are stuck like between huge buildings or subways, you will be tracked by GLONASS satellites accurately.

Using dual GPS/GLONASS receivers and antennas accelerates the time to the first fixation, and the M2M device may have two satellites at its disposal for determining location. This is particularly helpful for users who need reliable location information in challenging environments, such as urban canyons or environments where foliage, bridges, etc., often block large portions of the sky.

For optimal accuracy, a device needs to receive signals from more than one satellite, which underscores the advantages of dual-system receivers. Receivers must have an unobstructed line of sight to four or more satellites.

Obviously, mobile applications like auto location contend with varying blocked parts of the sky, change performance along a route. Dual-system receivers and antennas deliver a clear advantage for high-precision positioning in such applications. In fact, Taoglas' real-world driving tests reveal quicker time for the first fixations, with accuracy improving from meters to one meter.

In October of 2012 researchers at Taoglas conducted a series of tests with various single- (GPS only) and dual-system (GPS + GLONASS) antennas while driving two routes in San Diego, California.

Zero test, that was called "Unobstructed-Sky Test", showed that in open ground environments, with few or no trees, no buildings, and nothing to block the sky, all global satellite systems worked well all day long, every day. The only difference was only in the speed of the time for the first fixation.

There is no doubt, that the test in the unobstructed environment isn't realistic. Therefore, next tests were in San Diego.

The first test involved a passive antenna, which is the least-expensive variety. A GPS-only antenna and a dual GPS/GLONASS antenna also were tested. Results were uncertain – coverage changed when driving underneath buildings or even when turning a corner and it showed, that both GPS and GLONASS antennas are effective. However, positioning is less accurate overall than with other antenna types.

In the second test, the dual-system antenna offered better accuracy. However, the results were much less dramatic, because active antennas delivered more accuracy overall than their passive counterparts, with the highest accuracy coming from dual-system antennas.

The last test was considered with external antenna and the expectations were higher than what actually occurred. Since this was an active antenna, the results should have been similar to those with the other active antennas. The researchers ultimately deduced that the cable loss contributed to less performance.

Therefore, these tests showed that the dual-system antenna really performed the best results in that difficult downtown environment.

Finally, it's important to underline that after the comparison of GPS and GLONASS it isn't difficult to conclude that GLONASS is the most accurate navigation system in northern latitudes andRussia. But the tests described above have shownthat the best accuracy is achieved only when GPS and GLONASS are used simultaneously.

Today there is no navigation system that can determinate your position without inaccuracy, therefore one can say that GPS is like love, you can never be sure where it will take you.

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3Д печать в медицине

Статья посвящена актуальности внедрения такой технологической новинки как 3D печать в важнейшую сферу нашей жизни - медицину. В ней обобщается практический опыт применения такого вида печати для восстановления функций человеческого организма и разобраны примеры успешного проведения операций соответствующего рода. Значительное внимание уделяется возможностям, которые открывает 3Dпечать перед медициной, хирургами и пациентами. В конце статьи предполагается возможное будущее 3D печати в медицине, акцентируется внимание на необходимости этого, нужных мерах по всеобщему внедрению и финансированию.

3D Printing in medicine

“3D printing is revolutionizing every aspect of the medical industry. It saves time, it saves more lives and it improves the efficiency of the surgery as well”

Dr Muhanad Hatamleh